



Name:

Date:

Student Exploration: Coral Reefs 1 – Abiotic Factors

Directions: Follow the instructions to go through the simulation. Respond to the questions and prompts in the orange boxes.

Vocabulary: consumer, coral, coral bleaching, coral reef, filter feeder, food chain, food web, grazer, nutrients, ocean acidification, pH, plankton, predator, producer, sediment, zooxanthellae

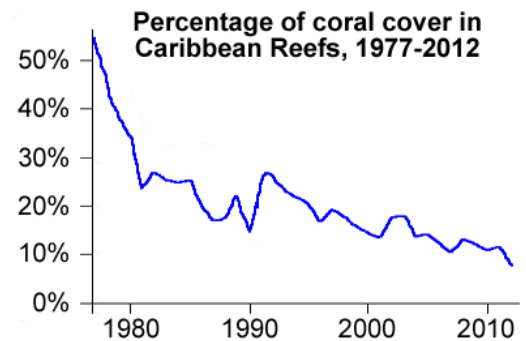
Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. Look at the graph to the right. What does it show?

Based on my observation, the graph is about percentage of coral cover in caribbean reefs through the years 1977-2012.

2. Why do you think **corals** have declined since 1977?

I think the corals have declined since 1977 because of global warming. I think so because since the earth is warming up so is the water and it could be that the coral cant live with the temperature.



Gizmo Warm-up

Coral reefs are some of the most diverse habitats on Earth, home to over a quarter of all marine species. The *Coral Reefs* Gizmo provides a simplified model of interactions among 10 key species in Caribbean reefs. In the *Coral Reefs 1* exploration, you will focus on the effects of environmental factors on Caribbean reefs.



1. Click **Advance year** 10 times. Look carefully at the composition of the reef over time. Do you see any major changes?

After 10 years, the composition of the coral reefs are still the same but the sea urchins kept decreasing and increasing.

2. Select the **DATA** tab. Check that **Staghorn coral**, **Star coral**, **Sponges**, and **Algae** are selected. Populations are given as a percentage of normal populations. What do you notice about these populations?

Based on the data, the populations in the coral reefs are saying the same but the sponges which are the color peach in the graph shows how it increased.

3. On the right side of the Gizmo, select the **SUMMARY** tab. In a healthy reef, what are the values for **Nutrient load**, **Water clarity**, **Coral cover**, and the total number of fish species?

Nutrient load: 4 ppt

Water clarity: 94%

Coral cover: 49%



Total fish species: 442

Activity A: The Caribbean reef ecosystem	<p><u>Get the Gizmo ready:</u></p> <ul style="list-style-type: none"> On the CONDITIONS tab, click Return to original settings. Click Restart. Select the CORAL REEF tab. 	
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Introduction: A healthy Caribbean reef is home to over 50 species of coral and over 400 fish species. In this simplified model, we only consider the interactions of ten important species.

Question: How do different species interact in a healthy coral reef?

- Describe: On the CORAL REEF tab, click on each organism shown in the table below. For each organism, give its name and what it eats (or how it obtains energy).

Picture	Name	What it eats (or how it obtains energy)
	Staghorn coral	Staghorn coral obtains energy from photosynthetic symbiotic algae
	Boulder star coral	Boulder Starcoral obtains energy from photosynthetic symbiotic algae
	Sponges	Sponges eat plankton suspended in the water.
	Algae	algae eat the nutrients that lay in the water.
	Stoplight parrotfish	Stoplight parrotfish they feed on algae.
	Queen angelfish	Queen angelfish eats the sponges
	Yellowtail snapper	Yellowtail snapper feeds on shrimp, small fish, crabs and worms.
	Nassau grouper	Nassau grouper feeds on reef fish like the Yellowtail snapper, Stoplight parrotfish and Queen angelfish.
	Long spined sea urchin	Long spined sea urchin feeds off of algae.
	Hawksbill sea turtle	Hawksbill sea turtle feeds on sponges.

2. Corals obtain energy from tiny photosynthetic algae, called **zooxanthellae**, which live inside the coral's tissue. How do you think corals would be affected by cloudy, muddy water?

A cloudy and muddy water will affect the corals because algae needs the sun and clean water. Water and the sunlight are 2/3 major things needed for photosynthesis. If the algae cant make the energy for the coral then it'll slowly die.

3. **Classify:** A **producer** is an organism that makes its own energy, usually from sunlight. A **consumer** is an organism that gets energy by feeding on other organisms.

- A. Which of the reef organisms in this Gizmo are producers?

Producers (2): algae, Sponges

- B. Which of the reef organisms are consumers?

Consumers (8): staghorn coral, Boulder star coal, Stoplight parrotfish, Queen angelfish, Yellowtail snapper, Nassau grouper, Long spined sea urchin, and Hawksbill sea turtle.

- C. Consumers in the reef can be further classified as **filter feeders**, or organisms that eat **plankton** by filtering water; **grazers**, or organisms that feed on organisms that don't move; and **predators**, or organisms that eat other animals. List at least one example of each.

Filter feeders:

(1) Sponges

Grazers:

(4) Sea turtles, Queen angelfish, Long spined sea urchin, Stoplight parrotfish

Predators:

(2) Nassau grouper, Yellowtail snapper

4. **Create:** A **food chain** is a series that shows which organisms obtain energy from other organisms. For example, the food chain "grass → mouse → hawk" means that the mouse eats grass and the hawk eats the mouse.

Create two possible food chains for the Caribbean coral reef based on what you have learned about the ten organisms in this Gizmo.


Food chain 1:

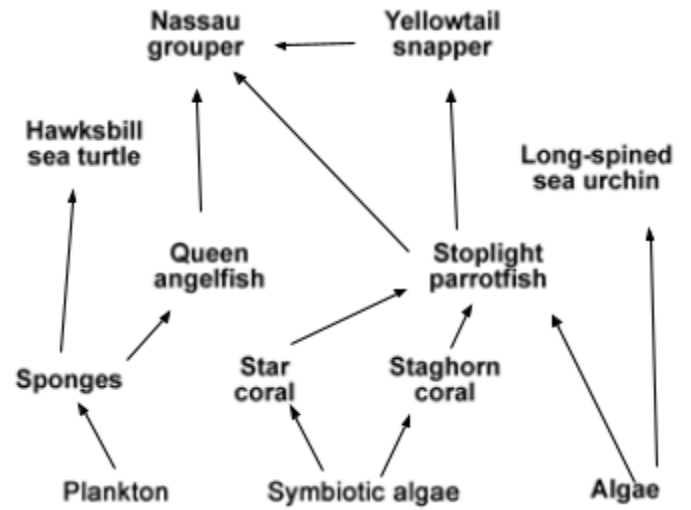
algae → parrotfish → grouper


Food chain 2:

symbiotic algae → staghorn coral → parrotfish → yellowtail snapper

5. **Challenge:** A **food web** is a more complicated diagram that shows the feeding relationships of all the organisms in the ecosystem. As with a food chain, an arrow pointing from species A to species B indicates species B gets its energy from species A.

 In the diagram at right, create a food web by drawing arrows (→) to show which organisms obtain energy from others. Hand draw or click on the image and select EDIT.



Activity B: Ocean conditions	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> On the CONDITIONS tab, Click Return to original settings and Restart. Check that Ocean conditions is selected on the dropdown menu. 	
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Introduction: In recent decades, global climate change has altered ocean conditions in the Caribbean. Average surface temperatures have risen about 0.25 °C – 0.5 °C. Many scientists think climate change will lead to stronger storms and may cause the ocean to be more acidic.

Question: How are coral reefs affected by storms, high temperatures, and acidic water?

- Predict: Coral reefs in the Caribbean are sometimes damaged by hurricanes. Of the two types of coral shown, which do you think is more resistant to storm damage? Explain.

I think the staghorn coral is more resistant to storm damage because of the way it's shaped.

- Observe: Set the **Storm severity** to 50%. Click **Advance year** 10 times. What changes do you notice?

I see that increase of boulder star coral but a decrease in staghorn.

- Analyze: On the **DATA** tab, select **Staghorn coral**, **Star coral**, **Sponges**, and **Algae**. Which organism was most hurt by increased storms, and why do you think this is so?

The organism that was hurt the most by the increase of storms was staghorn coral, I think so because of the way its shape.

- Predict: In the Caribbean, water temperatures typically range from 24 °C to 30 °C. What do you think might happen if temperatures rise much higher than 30 °C?

I think that either some won't last or it will grow a certain species.

- Observe: Select the **CORAL REEF** tab. Click **Return to original settings** and **Restart**. Set the **Ocean temperature** to 33 °C. Click **Advance year** 10 times.

A. What changes do you notice?

I noticed that there is an increase of algae and a decrease of staghorn coral.

The white corals you see have undergone **coral bleaching**. At high temperatures, corals may lose their zooxanthellae, causing corals to lose their color and their main source of food. Once bleaching occurs, the coral colony usually dies.

B. Select the **DATA** tab. Which coral is most affected by bleaching?

It was the staghorn coral.

6. **Analyze:** On the DATA tab, select every organism. In general, how does the decline in corals affect the other organisms on the reef?

All of the organisms were decreasing but the only one increasing was algae.

7. **Predict:** The **pH** of a solution is a measure of how acidic or basic it is. The greater the pH, the more basic the solution is. Corals and other marine invertebrates require less energy to make their exoskeletons and shells when ocean water is slightly basic. As carbon dioxide concentrations in Earth's atmosphere rise, ocean water absorbs carbon dioxide and becomes more acidic. This process is called **ocean acidification**. How do you think ocean acidification will affect the coral reef?

I think it will require more energy to make their exoskeletons.

8. **Observe:** Click **Return to original conditions** and **Restart**. Set the **Ocean pH** to 7.6. Click **Advance year 20** times. What changes do you see on the CORAL REEF and DATA tabs?

I see that the reefs show less staghorn coral and the graphs shows that the two corals were most affected which are the boulder star coral and staghorn.

9. **Observe:** Select the SUMMARY tab. How has the loss of coral affected the number of fish species present on the reef?

The number decreased by a little more than half since it first started at 442 and now there is 294.

10. **Summarize:** Many scientists predict stronger storms, warmer oceans, and lower ocean pH in the future. If this occurs, how do you think these changes will affect Caribbean coral reefs? Test your ideas using the Gizmo.

It caused damage to the reefs. The staghorn coral is completely gone. The ones not affected by it were algae, nassau grouper, yellowtail snapper, red lionfish crown-of-thorn starfish.

11. **Apply:** In the 1970s, staghorn corals dominated Caribbean reefs. Since that time, staghorn corals have declined by over 90% and are now classified as critically endangered. What do you think are the causes of this decline, and why do you think staghorn corals are so vulnerable?

Staghorn coral is affected easily. If it's less basic than the start decreasing in numbers. The staghorn coral is the most delicate coral of them all. They are also helpless against a disease called white band. On gizmos it also shows when you increase the storm severity the staghorn coral is depleting the quickest than the boulder star coral. I would also say the staghorn coral is like a branch off a tree they break easily and they are shaped in a

way it could be broken off. Unlike the boulder star coral it is like a rock you can still break it but it doesn't break that easy.